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Description: 12 pages
Drawings: 5 pages

[54] **Title of Invention**:

Movable Device for Sewing Machine

[57] **Abstract**:

This invention provides a sewing machine, which can realize oil-free operation by parts having frictional contacts and at the same time reduce manufacturing load and

achieve lightweight. Rice bran ceramic is used to form the sewing machine's frictional surfaces for rubbing contacts during its high speed and high load movements, such as sliding movements, rotating movements, etc. For example, as to shaft and bearing forming the sewing machine's driving mechanism, the bearing has a structure of a bearing bush shaped product made of rice bran ceramic securely embedded within a shell component made of metal as an outer bearing casing. In the above structure, the bearing's inner surface, which rubs on the shaft surface, is formed by the rice bran ceramic having low friction coefficient so as to realize oil-free operation.

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Claims

1. A m ovable device for sewing machine, having two components in mutual contact for relative sliding movements and rotating movements, characterized in that the contacting surface of at least one of said components is formed by a hard porous carbon material.

2. The m ovable device for sewing machine according to claim 1, characterized in that one of said two components has a metal annular part, the other component has a shaft part for fitting into said annular part, and the contacting surface of at least one of said parts is formed by a hard porous carbon material.

3. The m ovable device for sewing machine according to claim 1 or claim 2, characterized in that said contacting surface formed by the hard porous carbon material has many concave points based on the pores in said hard porous carbon material.

Description

Movable Device for Sewing Machine

The present invention relates to a sewing machine capable of realizing oil-free operation of its sliding and rotating parts.

In the past, an industrial sewing machine's driving mechanism, which has many components with parts for rubbing contacts with one another for high speed and high load sliding movements and rotating movements, is mainly formed by shafts and bearings. Furthermore, in a shaft and bearing structure, it is usually a combination between metal materials. In order to avoid cauterization or abnormal abrasion between metal materials, such as wear down by frictional corrosion, structures for supplying lubricants are used in many cases.

When lubricant is supplied to said contacting parts of an industrial sewing machine, since the lubricant has wear loss due to frictional heat at the contacting parts, it is necessary to fit an oil supply device for forced supply of lubricant. As an oil supply device, it comprises, for example, an oil distribution pathway for supplying lubricant to the contacting parts, a sump for storing lubricant, a pump for sucking the lubricant out, etc. On the basis of such a structure, the pump can suck the lubricant from the

sump, then via the oil distribution pathway, supply a lubricant circulation to each contacting part.

Furthermore, the wear generated by the sliding movements, rotating movements etc. and the resistance generated by the sliding movements, rotating movement etc. are, in a very big degree, influenced by the speed of the sliding movements, rotating movements etc. and by PV value determined by the surface pressure (load) applied during the sliding movements and rotating movements. That is to say, the higher is said speed or the higher is said surface pressure, the higher will be the friction rate, so will be the wear and the resistance produced by it.

However, in a sewing machine having the above-mentioned structure for supplying lubricant to the contacting parts, for example, when the supplied amount of lubricant is too much, and when its high-speed needle shaft is having up and down reciprocating movements, its thread holding rod is having swinging movements and its needle shaft crank arm rod is having rotating movements, it would happen that the lubricant would be splashed all around, and the lubricant would leak out the sewing machine frame to contaminate sewing fabric.

On the other hand, when the supplied amount of lubricant is too little, it would cause the contacting parts' abnormal abrasion and cauterization.

Furthermore, as mentioned above, if it has an oil supply device for supplying lubricant to contacting parts, the number of components in an sewing machine increases, which would not only increase manufacturing load and cost, but also the sewing machine's weight; therefore, there is a need for sewing machine's oil-free operation.

In order to realize oil-free operation, coating treatments have been made on the surfaces of metal materials as the rubbing surfaces of the contacting parts. For example, tests have been made on using ceramic films of TiN, DLC, etc., MoS_2 for lubricating effects, or coating a Teflon structure, or a structure of wear-resistant resin material or carbon fiber reinforced resin (CFRP).

However, the above-mentioned coatings on the metal material surface would wear out or peel off over a long time of use, thus losing their effects. Also, in the past the wear-resistant resin materials, generally speaking, have relatively large thermal expansion coefficient, therefore they would produce relatively large shape change due to the heat generated by the sliding movements, rotating movements, etc. Furthermore, in the past the wear-resistant resin materials, generally speaking, often require a lot of efforts in machining in order to achieve good enough precision, and it is easy to wear out.

Therefore, as mentioned above, in view of the above-mentioned facts the object of the present invention is to

provide a sewing machine, which can realize contacting parts' oil-free operation and at the same time reduce manufacturing load and achieve lightweight.

The sewing machine of the first aspect of the present invention has, e.g. as shown in Fig. 1, components with contacting p arts for rubbing contacts between themselves during the components' movements such as sliding movements, rotating movements, etc., characterized in that said contacting part of at least one of the components is formed by a hard porous carbon material.

According to the above-mentioned formation, due to the low friction coefficient of said hard porous carbon material, it can reduce the degree of wear when the parts have contacting movements between one another, and at the same time it can also reduce heat generation. Therefore, it can increase the contacting p arts' wear-resistance and cauterization-resistance, thus realizing oil-free operation.

Furthermore, since said contacting parts do not require lubricant supply, there is no need to fit an oil supply device having an oil distribution pathway, sump, pump etc. for supplying lubricant to a sewing machine, therefore a lightweight sewing machine can be realized.

Furthermore, said components having contacting parts are made of hard porous carbon material, which has density smaller than that of metal materials, so it can further realize a sewing machine's lightweight.

Furthermore, since there is no need for an oil supply device to supply lubricant, it can reduce the number of components in a sewing machine, so to reduce a sewing machine's manufacturing load, and at the same time it is helpful to cutting down manufacturing costs.

In addition, it can perform the actions of reciprocating linear sliding movements along an axial direction, or the actions of rotating movements around the centre of an axis, or the actions of both sliding movements and rotating movements at the same time.

Furthermore, the structure can be a shaft having a circular column shape for sliding movements along the axial direction, or rotating movements, or a combination of both, to match a bearing in an annular part of a cylindrical shape for inserting said shaft therein. Also, the structure can be a shaft of any cross-section shape for linear sliding movements along its longitudinal direction, to match a bearing in an inner tubular part of a shape corresponding to the cross-section shape of said shaft.

For example, if the structure of the first aspect of the present invention is adopted to those bearings fitted on a swing table (a needle shaft upper shaft lining 19A and a needle shaft lower shaft lining 19b), a thread hold rod sliding bearing, bearings having connecting rod relationship, etc., it would be able to realize oil-free operation very well.

Furthermore, when the structure of the first aspect of the present invention is adopted to said bearings, for example, parts made of hard porous carbon material in the shape of bearing bush are fixed to the inner surface of an outer casing component, it would form a very good structure.

Furthermore, it can be used as contacting parts, e.g. for a traveling block of the driving mechanism in a sewing machine and a sliding groove fitted for guiding said traveling block, which includes the conditions of said traveling block's frictional contacts and movements along the sliding groove. In this case, if the rubbing parts of the traveling block and the guiding groove are made of the hard porous carbon material , it would be able to realize oil-free operation very well.

Furthermore, if the use of said structure of hard porous carbon material on the rubbing surface of the sewing machine's contacting parts is combined with the arrangement to supply lubricant to the contacting parts, it can achieve reduced oil supply.

Furthermore, as to the parts that should be made of the hard porous carbon material , it can have, among the rubbing surfaces of several parts, only the rubbing surface of one part made of the hard porous carbon material , or it can also have all surfaces having said rubbing contacts formed by the hard porous carbon material.

Furthermore, as to several components themselves at the contacting positions, each of them can be made of the hard porous carbon material.

Furthermore, parts made of the hard porous carbon material can also be fixed on the rubbing surface of a metal part, which serves as a base material. In addition, when fixing parts of the hard porous carbon material over a shaft component, it can be done by, e.g. adhesive, or by mechanical means of fixing by screws.

Furthermore, said hard porous carbon material is made by a manufacturing process of, for example, using a composite material containing at least a fiber material and a resin, which includes the step of making shaped products from said composite material and the step of carbonizing said shaped products by firing.

For example, in the process of polishing brown rice to produce white rice it would produce rice bran. Precisely speaking, after oil has been removed from rice bran, the de-oiled bran is a very good fiber material. Said de-oiled bran is impregnated with a resin, then it is made into shaped products by pressing. After that, the shaped products are dried and the dried shaped products are placed in an inert gas, such as nitrogen, environment for thermal treatment until they are carbonized. The product produced by this process is rice bran ceramic.

In this case, since the pro ducts will not cause damage to natural environment when discarded after use, they are environment friendly. At the same time, the raw material (de-oiled bran) is abundant and its supply is stable and reliable. Furthermore, if de-oiled bran is used, it can reduce the use of timber, thus restraining the logging of limited forest resources in the world.

Furthermore, as to said resin used in producing the rice bran ceramic, many types of resin materials can be used as long as they can be carbonized by thermal treatment. Specifically, e.g. it is preferred to use thermosetting resins such as phenol resins, etc.

With the hard porous carbon material produced by the above-mentioned process, said shaped products can be manufactured e.g. by mould, or they can be easily manufactured by many kinds of widely applicable processing such as injection and cutting, etc. Therefore, shaped products having complicated shapes can be easily produced, and the manufacturing costs can be controlled to a low level.

Furthermore, as to said hard porous carbon material , in the process of having the shaped products carbonized by firing, because of the property that its hardness can be adjusted by the firing temperature, the products can be made to have a required hardness.

Furthermore, as to said hard porous carbon material , because its porosity changes with the firing temperature, it has a property of adjustable density. Therefore, its density can be made to correspond to the working conditions of PV value.

The sewing machine of th e second aspect of the present invention, including the sewing machine of the first aspect of the present invention, is characterized in that one of said two components has a metal annular part, the other component has a shaft part for fitting into said annular part, and the contacting surface of at least one of said parts is formed by a hard porous carbon material.

According to said structure, the contacting surface, which serves as a rubbing surface, is made of said hard porous carbon material , and it can realize oil-free operation in the same way as the first aspect of the present invention.

Furthermore, the structure of said shaft part and annular part, e.g. as shown in Fig. 1, is suitable to forming the shaft and bearing of the driving mechanism in a sewing machine, so as to realize oil-free operation for the contacting parts of said shaft and bearing.

In this case, the materials for outer tubular part and inner tubular part are not necessarily the same material. They can also be made of many types of materials.

Furthermore, the hard porous carbon material as the inner tubular part material can be in any shape, such as cylindrical, plate shape, etc., as long as they can be fixed to serve as said rubbing surface.

The sewing machine of the third aspec t of the present invention, including the sewing machine of the first or second aspect of the present invention, is characterized in that said contacting surface formed by the hard porous carbon material has many concave points due to the pores in said hard porous carbon material.

According to said structure, at least the concave points on the rubbing surfaces of two materials, which maintain mutual rubbing contact, would contain rubbing powder produced during the initial stage of rubbing. The rubbing powder contained in the concave points would reduce friction coefficient (self-lubricating) during the rubbing contact, so as to realize oil-free operation.

Furthermore, according to said structure, on the rubbing surface said hard porous carbon material has pores forming many concave points , and the concave points can be impregnated with a lubricant such as a lubricating grease , therefore, it can further improve wear-resistance and cauterization-resistance.

As mentioned above, said hard porous carbon material can change its density (porosity) according to manufacturing conditions, therefore, e.g. a hard porous carbon material

with a high porosity can be made and impregnated with a lubricant such as a lubricating grease. Because a lot of lubricant can be impregnated, it can further improve wear-resistance and cauterization-resistance.

Furthermore, as to said hard porous carbon material , because it is a porous material, it also has a lot of pores in its internal structure. Therefore, even if the surface of the hard porous carbon material is worn out, new pores will be exposed from inside, which can form many concave points on the surface.

Descriptions are made hereinbelow to the accompanying drawings and symbols.

Fig. 1 is an exploded perspective view of a driving mechanism for a sewing machine 10 according to a first embodiment of the present invention;

Fig. 2 is a side view of the above-mentioned driving mechanism for the sewing machine 10;

Fig. 3 is an exploded perspective view of a driving mechanism for a modified embodiment of sewing machine 20;

Fig. 4 is a side view of a thread feeding shuttle holding seat as the contacting part of a sewing machine; and

Fig. 5 is a cross-sectional view of a bearing with a shaft bush made of rice bran ceramic fixed on its inner surface, and also a structural diagram of the rice bran ceramic' cross-section.

In the above drawings, 10, 20 - sewing machine; 11 - upper shaft (shaft part); 1D - swinging shaft (shaft part); 12B, 18A, 16A, 23A, 23B - shafts (shaft parts); 27A - shaft; 17 - needle rod; 100 - bearing (annular part); 11A - upper shaft front bearing; 19A - needle rod upper bearing (annular part); 19B - needle rod lower metal part (annular part); 1CA - swinging shaft metal part (annular part); 11Aa, 13A, 13C, 15A, 19Aa, 19Bb, 1Ca, 22A, 24A, 24B, 27A - inner tubular parts; 101 - casing part (outer tubular part); 102 - shaped product (inner tubular part); 102B - concave point.

Embodiments

Hereinbelow, a sewing machine 10 of the first embodiment of the present invention is described with reference to Figs. 1 and 2.

In a conventional sewing machine fitted with an oil supply device, the contacting parts of a driving mechanism, which is for sliding movements, rotating movements, etc., are the centre for oil supply. Descriptions are made below around the main subject matter which is the contacting parts of the driving mechanism of sewing machine 10 in the first embodiment. As to the structures other than the driving mechanism, the same structures as in a conventional sewing machine are applicable.

The sewing machine 10 in the first embodiment has a frictional driving mechanism, which has a shaft and a bearing matching said shaft for sliding movements and

rotating movements. Furthermore, it has an upper shaft 11 for rotating movements, an upper shaft front bearing 11A working as a bearing for shaft 11, a needle shaft crank arm rod 13 for converting the rotating movements by the upper shaft 11 into up and down sliding movements, a thread holding rod 16 for supply tope thread to machine needle 1B, a thread holding rod sliding bearing 15 working as a bearing for an upper shaft 16A of said thread holding rod 16, a needle shaft 17, a needle shaft holding seat 18 on said needle shaft 17, a swing shaft 1D for swinging movements, a swing table 19 having a needle shaft upper bearing 19A and a needle shaft lower metal part 19B, a sliding block 14 for sliding movements in up and down direction guided by a sliding groove 19C on said swing table 19, and a swing metal part 1C as a bearing for the swing shaft 1D.

Furthermore, among the parts of said structure, the shaft and bearing parts for sliding movements and rotating movements have, e.g. the structure of bearing 100 (annular part) as shown in Fig. 5(b).

That is, as to the bearin g 100, inside a metal-made cylindrical shaped casing part 101 (outer tubular part) of said bearing 100, there is securely embedded a shaft bush shaped product 102 (inner tubular part) made of rice bran ceramic (as mentioned above). Furthermore, said bearing 100 uses the inner surface 102A of the shaft bush shaped product 102 as the bearing surface for matching a shaft (shaft part,

now shown in the drawing) for movements such as sliding movements, rotating movements, etc. Also, as shown in Fig. 5(a), on the inner surface 102A, which as a rubbing surface makes contacts with the shaft surface (not shown in the drawing), there are many concave points 102B formed by the pores in the rice bran ceramic, which contains rubbing powder 102C produced during the initial period of rubbing. When the shaft (not shown in the drawing) rubs against the inner surface 102A, the rubbing powder 102C has the effects of solid lubricant, so it is a material that can realize oil-free operation.

As shown in Figs. 1 and 2, the upper shaft front metal part 11A has an inner tubular part 11Aa, and on the inner surface of said inner tubular part 11Aa there is securely embedded a shaft bush made of rice bran ceramic. The upper shaft front metal part 11A works as a bearing for supporting the rotating movements of the upper shaft 11, which can freely slide and rotate.

On one end of the upper shaft 11, there is fixed a balancing weight 11B. Said balancing weight 11B has a matching hole 11Ba, which is the hole 11Ba for securely connecting the balancing weight 11B to a connecting shaft 12 of the needle shaft crank arm rod 13.

On said connecting shaft 12, there is formed a dent 12A. Also, the balancing weight 11B has threaded holes 11Bb and 11Bb. By fitting screws 11Bc and 11Bc into the thread

of 11Bb and 11Bb, the connecting shaft 12 is fixed in the matching hole 11Ba of the balancing weight 11B. In this way, the balancing weight 11B can rotate with the connecting shaft 12 integrally.

The needle shaft crank arm rod 13 has an inner tubular part 13A, which can support a shaft 12B on said connecting shaft 12 for freely sliding and rotating, a matching hole 13B for fitting a shaft 15B of a thread holding rod slid bearing 15, and an inner tubular part 13C for a freely slidable and rotatable fitting of a shaft 18A on the needle shaft holding seat 18. In the inner tubular part 13A and the inner tubular part 13C, there are securely embedded shaft bushes made of rice bran ceramic, working as bearings for the sliding movements and rotating movements of the shaft 12B and shaft 18A, respectively.

The thread holding rod slid bearing 15 has an inner tubular 15A, and at the same time it also has a shaft 15B for fitting into a matching hole 13B of the needle shaft crank arm rod 13. In the inner tubular 15A, there is securely embedded a shaft bush made of rice bran ceramic, serving as a bearing for supporting the shaft 16A of the thread holding rod 16 for freely sliding and rotating.

As to the needle shaft holding seat 18, a screw 18C is fitted in the thread of a threaded matching hole 18B of the needle shaft holding seat 18, so as to fix the needle shaft holding seat 18 onto the needle shaft 17. Furthermore, the

needle shaft holding seat 18 has the shaft 18A, which is fitted into the inner tubular part 13C of the needle shaft crank arm rod 13.

As to a sliding block 14, in a matching hole 14A of the block 14 there is securely fitted the end part of the shaft 18A inserted through the inner tubular part 13C on the needle shaft crank arm rod 13.

Furthermore, the sliding block 14 is guided by a sliding groove 19C on the swing table 19, so as to slide in up and down direction along said sliding groove 19C. In this way, the needle shaft 17 can move in up and down direction relative to the swing table 19. The sliding block 14 is completely made of rice bran ceramic, and the two side surfaces and the back surface of this sliding block 14 have rubbing contacts with the sliding groove 19C for sliding movements along the groove 19C.

As to the sliding block 14, it is not restricted to make this sliding block 14 completely by rice bran ceramic. It is also possible to fix rice bran ceramic parts on the two side surfaces and the back surface of the sliding block 14 as surfaces for rubbing with the sliding groove 19C.

As to the swing table 19, it has a needle shaft upper bearing 19A on its upper part, a needle shaft lower bearing 19B on its lower part, and the sliding groove 19C for guiding the sliding block 14. Also, one end of the swing

shaft 1D is fixed onto the swing table 19, making the table to have integral swing movements with the swing shaft 1D.

The needle shaft upper metal part 19A has an inner tubular part 19Aa, and the needle shaft lower metal part 19B has an inner tubular part 19Ba. In the inner tubular part 19Aa and the inner tubular part 19Ba, there are securely embedded shaft bushes made of rice bran ceramic. The needle shaft upper metal part 19A and the needle shaft lower metal part 19B work as bearings to support the free sliding movements in up and down direction by the needle shaft 17, which is fitted in the connection structure of the needle shaft upper metal part 19A and the needle shaft lower metal part 19B.

Furthermore, the parts of the sliding groove 19C that have contacts with the sliding block 14 can also used fixed parts made of rice bran ceramic.

Furthermore, at the lower part of the swing table 19, there is a needle fitting block 1A for fitting a needle 1B. Said needle fitting block 1A has a threaded shaft 1AA, and the lower end of the needle shaft 17 fitted in the swing table 19 has a threaded matching hole 17A, which is for securely connecting the shaft 1AA by thread. While in the needle fitting block 1A, screws 1AC and 1AC can fix the needle through a threaded matching hole 1AB.

The swing shaft's bearing 1C has in inner tubular part 1CA, in which is securely embedded a shaft bush made of rice

bran ceramic. The swing shaft's bearing 1C works as a bearing for the swing shaft 1D's swing movements.

As to the rice bran ceramic, in its n ormal manufacturing process its hardness can be set because it would change with the firing temperature during its manufacturing. Therefore, the hardness of the rice bran ceramic used in this embodiment is set within the Vickers hardness (HV) range of about 40 ~ 150 (Mpa), which can be used for a sewing machine's sliding and rotating parts.

Furthermore, the rice bran ceramic's porosity would, similarly, change with the firing temperature, therefore its density is adjustable. For this reason, as far as a sewing machine is concerned, the density is set in the range of about $1.08 \times 10^3 \sim 2.0 \times 10^3$ (kg/m^3). In this case, it would be able to achieve a lightweight of 5 ~ 8 times if compared with copper, or a lightweight of 1 ~ 3 times if compared with aluminum.

For this reason, as described above, when rice bran ceramic is used as bearing, since it can achieve lightweight, it would reduce surface pressure when a shaft and bearing rubs or contacts, so it is helpful in reducing PV value and can improve wear-resistance and cauterization-resistance.

When it is used at contacting parts under the condition of a high PV value, lubricant such as lubricant grease, etc. can be impregnated into the pores. This would further

improve wear-resistance and cauterization-resistance. In addition, if increased porosity is used, i.e. by a structure of rice bran ceramic with reduced density impregnated with a lubricant agent, it would also improve wear-resistance and cauterization-resistance.

Furthermore, the rice bran ceramic can have its friction coefficient set within the range of 0.06 ~ 0.18 according to the firing temperature during its manufacturing process.

Furthermore, said rice bran ceramic can have its compressing strength set within the range of 50 ~ 100 MPa according to the firing temperature during its manufacturing process.

Hereinbelow, as to the manufacturing process of the sewing machine 10 in the first embodiment, except that the rubbing surface parts of the contacting components are made of rice bran ceramic, all the other components of each said structure in the driving mechanism of said sewing machine 10 can be manufactured in the same way as in a conventional sewing machine.

Namely, shaft bushes made of rice bran ceramic by the above-mentioned manufacturing process are securely embedded by adhesive or mechanical fixation (e.g. fixation by screws) on, for example, the rubbing surface parts of the inner surfaces of the inner tubular parts 11Aa, 13A, 13C, 15A, 19Aa, 19Ba, 1CA, as the bearing part in the upper shaft

front metal part 11A, the needle shaft crank arm rod 13, the thread holding road sliding bearing 15, the swing table 19, the swing shaft metal part 1C, etc.

Furthermore, as to the sliding block 14, for example, said sliding block 14 can be completely made of rice bran ceramic. In this case, the rubbing surface parts can also be formed by components made of rice bran ceramic fixed by adhesive or mechanical fixation.

In addition, in each of the above structures, components having rubbing surfaces formed by rice bran ceramic can be used in manufacturing the sewing machine 10 in the same way as in the past.

According to the above first embodiment of the present invention, in the sewing machine 10 and for the bearing parts of the upper shaft front metal part 11, the needle shaft crank arm rod 13 and the sliding block 14, etc. the rubbing surface parts, which are for rubbing contacts, are formed by the rice bran ceramic having low friction coefficient. Furthermore, on said rubbing surfaces, since there are many concave points formed by the pores, they can contain rubbing powder that serves as solid lubricant. For this reason, the degree of wearing can be reduced and at the same time heating is also limited, so it realizes the sewing machine 10's oil-free operation.

Furthermore, since there is no need to supply lubricant oil, it is not necessary to fit a oil supply device for

supplying lubricant oil, thus it can achieve a lightweight sewing machine. Further, since the low density rice bran ceramic is used, it can also achieve the sewing machine's lightweight.

Particularly, in the embodiment, since the swing table 19 is completely made of rice bran ceramic, it can reduce the PV value on the swing shaft bearing 1C, which supports the swing shaft 1D fixed onto the swing table 19, thus improving the swing shaft metal part 1C's wear-resistance. Furthermore, since it can reduce the swing table 19's swing inertia, so the needle shaft can swing correctly to form a nice thread trace.

Furthermore, since the oil suppl y device is not required, it can reduce the number of components in a sewing machine, thus reducing a sewing machine's manufacturing load and at the same time cutting down the manufacturing costs.

Furthermore, as a modified version of the present embodiment, it is also suitable to the driving mechanism of the sewing machine 20 shown in Fig. 3.

In Fig. 3, a driving mechanism includes: a balancing weight 21; a thread holding rod crank arm 22; a connecting shaft 23 for connecting the balancing weight 21, the thread holding rod crank arm 22 and a crank arm rod 24; a crank arm rod 24 for converting rotating movements to up and down movements; a sliding block 25 fixed to said crank arm rod; a needle shaft 26 for holding at its lower end a needle 29; a

needle shaft holding seat 27 for connecting said needle shaft 26 to the crank arm rod 24; and a needle fitting block 28 fixed at the lower end of the needle shaft 26.

When the driving mechanism of said sewing machine 20 works, the inner surface of the inner tubular part 22A carried by the thread holding rod crank arm 22 and the surface part of the shaft 23A carried by the connecting shaft 23, the inner tubular part 24A carried by the crank arm rod 24 and the surface part of the shaft 23B carried by the connecting shaft 23, the inner tubular part 24B carried by the crank arm rod 24 and the surface part of the shaft 27A carried by the needle shaft holding seat 27, are the contacting positions for rubbing contacts between shafts and bearings.

Therefore, shaft bush shap ed components made of rice bran ceramic are securely embedded on the inner surface of said inner tubular parts 22A, 24A and 24B, so that when the driving mechanism of the sewing machine 20 works, it can realize oil-free operation.

Furthermore, same as the sewing machine 10 in the first embodiment, when the sliding block 25 has rubbing contacts with other parts, the rubbing surface parts of this sliding block 25 can also adopt the structure of fixing components made of rice bran ceramic.

Furthermore, as sh own in Fig. 4, it is also applicable to a thread feeding shuttle holding seat bearing 40.

As shown in Fig. 4, the thread feeding shuttle holding seat bearing 40 has a thread feeding shuttle driving shaft 42 for driving a thread feeding shuttle, and a thread feeding shuttle guiding bearing 41 for supporting said thread feeding shuttle driving shaft 42, which is freely slidable and rotatable.

The surface of the thread feeding shuttle driving shaft 42, which is for sliding movements, rotating movements etc., and the inner surface 41Aa of the thread feeding shuttle guiding bearing 41 are the contacting parts for rubbing contacts. Therefore, by securely embedding shaft bush shaped components made of rice bran ceramic on the inner surface of the thread feeding shuttle guiding bearing 41, it can realize oil-free operation.

Furthermore, for example, the thread feeding shuttle guiding bearing 41 can be supported and fitted in a freely rotatable manner on a thread feeding shuttle guide support (not shown in the drawing). Furthermore, the surface 41a of the thread feeding shuttle guide metal part and the thread feeding shuttle guide support (not shown in the drawing) form the contacting parts for rubbing contacts. Therefore, it can adopt the structure of fixing components made of rice bran ceramic along the shape of the outer periphery surface of the thread feeding shuttle guiding bearing 41.

Furthermore, as to the thread feeding shuttle guiding bearing 41, its inner surface 41Aa and surface 41a are

rubbing surfaces, therefore, the structure of making the thread feeding shuttle guiding bearing 41 completely by rice bran ceramic can also be adopted.

Furthermore, as shown in Fig. 5(b), as to the components of the contacting parts (shaft 100), materials different from the hard porous carbon material can also be used to form the outer casing component (casing component 101), and at the same time use the structure of fixing components (shaped products 102) made of hard porous carbon material as the rubbing surface part of said outer frame component. In this case, the materials different from the hard porous carbon material, e.g. metal materials, etc. can give mechanical strength and endurance to the parts for rubbing contacts.

Of course, the hard porous carbon material can also be used in sewing machine components other than those described in the above embodiments.

The sewing machine according to the first aspect of the present invention uses the hard porous carbon material of low friction coefficient to make parts for forming said rubbing surfaces, so that oil-free operation can be realized.

Furthermore, without need for an oil supply device to supply lubricant to said contacting parts, it can therefore achieve lightweight. Furthermore, it can achieve

lightweight further by using e.g. the hard porous carbon material, which has a density smaller that that of metals.

Furthermore, since there is no need for an oil supply device, the number of components in a sewing machine can be reduced, thus reducing the sewing machine's manufacturing load and to cut down the manufacturing costs.

In the sewing machine according to the second aspect of the present invention, the shaft shaped parts have rotating movements along the periphery direction on the inner surface of the annular shaped parts or the sliding movements in an axial direction along the inner surface, and at the same time since their rubbing surfaces are formed by said hard porous carbon material, therefore, same as in the first aspect of the present invention, the shafts and bearings that form the sewing machine's driving mechanism can realize oil-free operation.

In the sewing machine according to the third aspect of the present invention, the rubbing surfaces have concave points, which contain rubbing powder produced during the initial period of rubbing, and said rubbing powder has self-lubricating properties by reducing friction coefficient during rubbing contacts, therefore oil-free operation can be realized.

Drawings Accompanying the Description

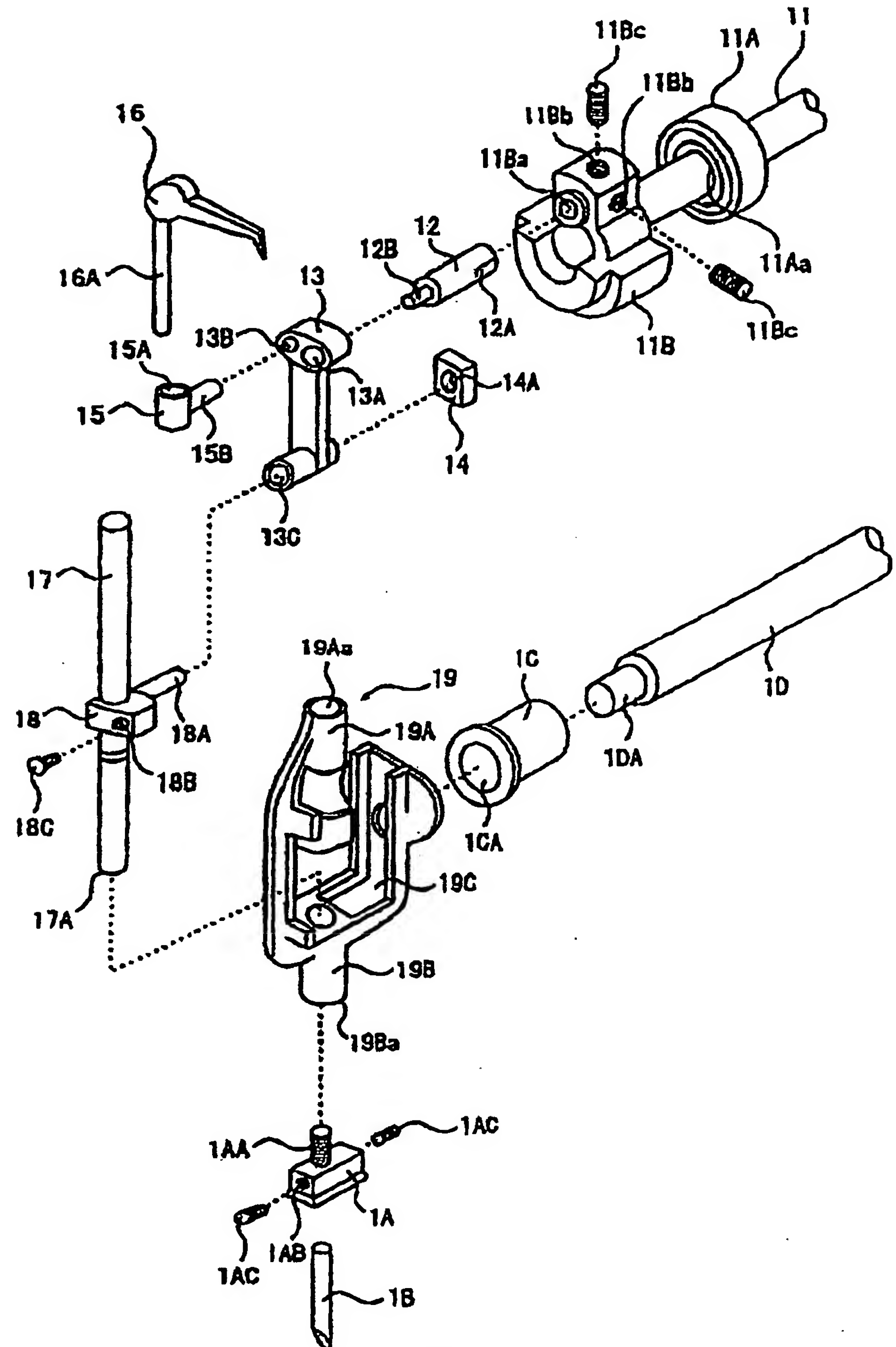

Figure 1

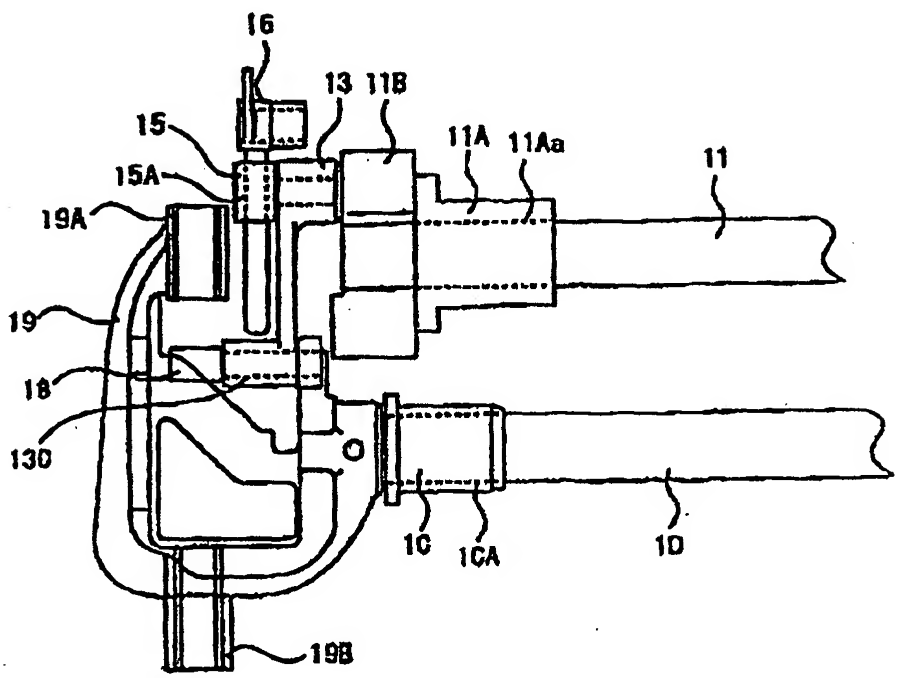

Figure 2

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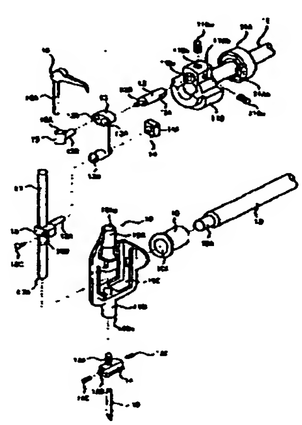
[54]发明名称 缝纫机的可动装置

[57]摘要

本发明提供一种缝纫机，能够实现摩擦接触部的无供油化，同时可 削减制造负荷，实现轻量化。用米糠陶瓷构成以高速、高负荷作滑动移 动和旋转移动等移动的缝纫机上又摩擦又接触的摩擦面。例如，对于构 成缝纫机驱动部的轴和轴承，轴承具有在由金属制成的作为轴承外框的 壳体构件的内部，固定嵌合由米糠陶瓷制成的轴瓦状成形品的结构；根 据上述结构，作为与轴的侧面相摩擦的轴承的内面，用摩擦系数小的米 糠陶瓷形成，能够实现无供油化。



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说　　明　　书

缝纫机的可动装置

本发明涉及一种能够实现滑动与旋转部分的无供油化的缝纫机。

以往，带有很多以高速、高负荷作滑动移动和旋转移动等部件彼此之间又摩擦又接触部分的工业用缝纫机的驱动部，主要是由轴和轴承构成。而且，轴和轴承的结构，一般的是金属材料彼此的组合，为不发生金属材料彼此的烧烤或异常磨损，例如磨蚀损耗，在很多场合采用供给润滑油的结构。

当向工业用缝纫机的所述接触部供给润滑油的时候，由于润滑油在接触部的摩擦生热而有磨损损耗，因此必须设置供油装置强制供给润滑油。作为供油装置具有，例如，向接触部供给润滑油的分配油路径，和储存润滑油的油盘，和将润滑油吸出的泵等。根据这种结构，能够由泵从油盘中吸出润滑油，同时经分配油路径，向各接触部循环供给润滑油。

而且，随着滑动移动、旋转移动等而产生的磨损和随着滑动移动、旋转移动等而产生的阻力，很大程度受由滑动移动或旋转移动等的速度以及滑动移动或旋转移动时所施加的面压力（负荷）决定的 PV 值左右。即，所述速度越大，或者所述面压力越大，摩擦率越大，磨损和所产生的阻力就越大。

但是，在具有向接触部供给润滑油的上述结构的缝纫机中，例如，当润滑油的供给量过多时，在以高速动作的针杆作上下往复运动、挑线杆作摇动运动和针杆曲柄连杆作旋转运动时，会发生润滑油向周围溅射、润滑油漏出缝纫机架外而弄脏缝料的现象。

而相反，当润滑油的供给量太少时，会产生接触部的异常磨损和烧烤。

而且，如上所述，若具有向接触部供给润滑油的供油装置，缝纫机的部件就会增加，这不仅仅只是增加了制造负荷和成本，也增加了缝纫

的轴与具有与该轴的截面形状吻合形状的内筒部轴承配合的结构。

例如，若能将本发明之 1 的结构适用于这些在摇动台上设置的轴承（针杆上轴衬 19A，针杆下轴衬 19b）、挑线杆滑动轴承、具有连杆关系的轴承等，就能够很好地实现无供油化。

而且，例如，本发明之 1 的结构适用于所述轴承时，例如，将由轴瓦状的硬质多孔性碳素材料作成的部件固定在构成外框部件的内侧面的结构也很好。

而且，作为接触部，例如，缝纫机的驱动部具有的行程块，为给该行程块导向设置的滑槽，包括该行程块沿滑槽摩擦接触，移动的情况。这时，如果行程块和滑槽的摩擦的部分用硬质多孔性碳素材料作成，就能够很好地实现无供油化。

而且，在缝纫机的接触部的摩擦面上使用上述硬质多孔性碳素材料的结构与向接触部供给润滑油的结构结合使用，也可以实现供油量的减少。

而且，应该用所述硬质多孔性碳素材料形成的部分，可以在多数部件的摩擦面中只有 1 个部件的摩擦面用所述硬质多孔性碳素材料形成，也可以在构成所述摩擦面的所有的面用所述硬质多孔性碳素材料形成。

而且，也可以将接触部的多数部件本身，各个都用所述硬质多孔性碳素材料作成。

而且，也可以在作为基础材料的金属部件摩擦面上固定由硬质多孔性碳素材料作成的部件。另外，在外轴构件上固定硬质多孔性碳素构件，例如，可以用粘接剂，也可以用螺钉固定的机械方法。

而且，所述硬质多孔性碳素材料，例如，至少是用含有纤维素材料和树脂的混合材料，通过包括由该材料制成成形品的工序和将该成形品烧成碳化工序的制造方法制成。

例如，在将糙米精制成白米的过程中产生米糠，正确地讲，从米糠中除去油的脱脂糠是很好的纤维素材料。在该脱脂糠中浸渗树脂，然后压缩制成成形品，在此之后，干燥制成干燥成形品，将该干燥成形品放入惰性气体，例如，氮气氛中进行热处理，碳化烧成，通过这些工序制

本发明之 3 的缝纫机，是本发明之 1 或 2 的缝纫机，其特征在于，用所述硬质多孔性碳素材料形成的所述接触面，基于所述硬质多孔性碳素材料的气孔，具有很多凹部。

根据该结构，至少在 2 个材料相互又摩擦又接触的摩擦面的凹部中，容纳有在磨损的初期阶段产生的磨损粉。在凹部中容纳的磨损粉，在又摩擦又接触时，能使摩擦系数降低（自润滑性），所以能够实现无供油化。

而且，根据所述结构，由于在摩擦面上硬质多孔性碳素材料所具有的气孔，形成很多凹部，所以，例如凹部中可浸渗润滑脂等润滑剂，能够进一步提高耐磨性和耐烧烤性。

如上所述，所述硬质多孔性碳素材料，根据制造条件能够改变密度（气孔率），所以，例如制成在高气孔率的硬质多孔性碳素材料中浸渗润滑脂等润滑剂的结构，由于可以浸渗很多润滑剂，因此能够进一步提高耐磨性和耐烧烤性。

而且，所述硬质多孔性碳素材料，由于是所谓多孔质材料，在其内部也存在很多气孔。所以，即使硬质多孔性碳素材料的表面由于磨削，还会露出内部的新孔，能够在表面上形成很多凹部。

下面，对附图以及符号进行说明。

图 1 为本发明实施例 1 缝纫机 10 驱动部的分解立体图。

图 2 为上述例缝纫机 10 驱动部的侧视图。

图 3 为上述例的变形例缝纫机 20 驱动部的分解立体图。

图 4 为作为缝纫机接触部的上线梭拱座部的侧视图。

图 5 为将由米糠陶瓷制成的轴瓦固定在内面上的轴承的剖视图和米糠陶瓷剖面的模式图。

在上述附图，10、20—缝纫机，11—上轴（轴状部件），1D—摇动轴（轴状部件），12B、18A、16A、23A、23B—轴（轴状部件），27A—轴，17—针杆，100—轴承（环状部件），11A—上轴前轴承，19A—针杆上轴承（环状部件），19B—针杆下金属件（环状部件），1CA—摇动轴金属件（环状部件），11Aa、13A、13C、15A、19Aa、19Bb、1Ca、22A、24A、24B、

部 11Aa 的内面上嵌合固定着用米糠陶瓷制成的轴瓦。而上轴前金属件 11A 作为支持作旋转移动的可自由滑动和旋转的上轴 11 的轴承。

在上轴 11 的一方的端部，固定着平衡锤 11B。该平衡锤 11B 具有配合孔 11Ba，该配合孔 11Ba 是能够固定接合平衡锤 11B 与针杆曲柄连杆 13 的接合轴 12 的孔。

在该接合轴 12 上，设有缺口 12A，同时平衡锤 11B 具有带螺纹的配合孔 11Bb、11Bb，通过螺钉 11Bc、11Bc 与 11Bb、11Bb 螺纹接合，将接合轴 12 固定在平衡锤 11B 的配合孔 11Ba 中。这样，能够使平衡锤 11B 与接合轴 12 一体旋转。

针杆曲柄连杆 13，具有内筒部 13A，该内筒部 13A 可自由滑动和旋转地支持所述接合轴 12 上的轴 12B，同时还具有与挑线杆滑动轴承 15 的轴 15B 嵌合的配合孔 13B，和与针杆拱座 18 的轴 18A 自由滑动，旋转嵌合的内筒部 13C。在内筒部 13A、内筒部 13C 上嵌合固定着由米糠陶瓷制成的轴瓦，它们分别作为作滑动移动和转动移动的轴 12B 轴、18A 的轴承。

挑线杆滑动轴承 15 具有内部筒 15A，同时还具有与针杆曲柄连杆 13 的配合孔 13B 嵌合的轴 15B。在内部筒 15A 上，嵌合固定着由米糠陶瓷制成的轴瓦，并作为支持挑线杆 16 的轴 16A 在其上可自由滑动和旋转的轴承。

针杆拱座 18，在该针杆拱座 18 的带有螺纹的配合孔 18B 中以螺纹接合着螺钉 18C，将针杆拱座 18 固定在针杆 17 上。而且，针杆拱座 18，具有轴 18A，该轴 18A 与针杆曲柄连杆 13 上的内筒部 13C 嵌合。

滑块 14，在该滑块 14 的配合孔 14A 中，嵌合固定着插入在针杆曲柄连杆 13 上的内筒部 13C 中的轴 18A 的端部。

而且，滑块 14 由摇动台 19 上的滑槽 19C 导向，沿该滑槽 19C 能够上下方向滑动。这样，针杆 17 就能相对于摇动台 19 在上下方向移动。滑块 14 全部由米糠陶瓷制成，该滑块 14 的两侧面和背面与滑槽 19C 又摩擦又接触，沿滑槽 19C 滑动。

滑块 14，并不限定于将该滑块 14 全部用米糠陶瓷制成，作为与滑

提高耐磨损性和耐烧烤性。

而当在高 PV 值条件的接触部使用时，可以向气孔内部浸渗润滑脂等润滑剂。这时能进一步提高耐磨损性和耐烧烤性。此外，若使用加大气孔率，即缩小密度的米糠陶瓷浸渗润滑剂的结构，也可提高耐磨损性和耐烧烤性。

而且，米糠陶瓷，在制造工序中能够根据烧成温度设定摩擦系数在0.06～0.18 的范围内。

而且，所述米糠陶瓷，在制造工序中能够根据烧成温度设定压缩强度在 50～100MPa 的范围内。

下面，实施例 1 的缝纫机 10 的制造方法，该缝纫机 10 驱动部的所述各结构的元件中，作为接触部分的摩擦面的部分由米糠陶瓷制造以外能够象以往的缝纫机同样制造。

即，上轴前金属件 11A、针杆曲柄连杆 13、挑线杆滑动轴承 15、摇动台 19、摇动轴金属件 1C 等的作为轴承的内筒部 11Aa、13A、13C、15A、19Aa、19Ba、1CA 的内面的摩擦面的部分上，例如，将通过上述的制造方法制造的由米糠陶瓷作成的轴瓦用粘接剂或机械固定的方法（例如，螺钉固定)嵌合固定。

而且，滑块 14，例如，该滑块 14 的全部由米糠陶瓷制成。这时，在摩擦面的部分，也可以将由米糠陶瓷制成的构件用用粘接剂或机械固定的方法固定。

另外，使用由米糠陶瓷形成的摩擦面的以上各结构的构件，与以往同样，也能够制造出缝纫机 10。

根据以上本发明的实施例 1 的缝纫机 10，上轴前金属件 11 和针杆曲柄连杆 13 等上的轴承部分和滑块 14 等的又摩擦又接触的摩擦面部分，用摩擦系数小的米糠陶瓷形成。而且，在该摩擦表面上，由于具有气孔造成的很多凹部，能够容纳起固体润滑剂作用的磨损粉。因此，能够降低磨损量，同时还可抑制发热，实现缝纫机 10 的无供油化。

而且，由于不用供给润滑油，所以就没有必要设置为供给润滑油的供油装置，能够实现缝纫机的轻量化。而且由于使用密度小的米糠陶瓷，

作滑动移动和转动移动等上线梭驱动轴 42 的侧面和上线梭导向轴承 41 的内面 41Aa 成为又摩擦又接触的接触部。所以，在上线梭导向轴承 41 的内面，嵌合固定用米糠陶瓷制成的轴瓦状构件，能够实现无供油化。

而且，上线梭导向轴承 41，例如，可自由旋转地支持和设置在上线梭导向支撑（图中未出示）上。而且，上线梭导向金属件的侧面 41a 和上线梭导向支撑（图中未出示）成为又摩擦又接触的接触部。所以，可以采用沿上线梭导向轴承 41 外周面形状固定用米糠陶瓷制成的构件的结构。

而且，上线梭导向轴承 41，其内面 41Aa 和侧面 41a 是摩擦面，所以，也可以采用将上线梭导向金属件 41 全部用米糠陶瓷形成的结构。

而且，例如图 5（b）所示，对于接触部的部件（轴承 100），可以采用使用与硬质多孔性碳素材料不同的材料形成外框的部件（壳体构件 101），同时在作为该外框的构件的摩擦面部分，固定用硬质多孔性碳素材料制成的构件（成形品 102）的结构。这时，作为与硬质多孔性碳素材料不同的材料，例如，使用金属材料等，能够赋予又摩擦又接触的部件机械强度和耐久性。

当然，也可将硬质多孔性碳素材料适用于上述实施例说明以外的缝纫机部件。

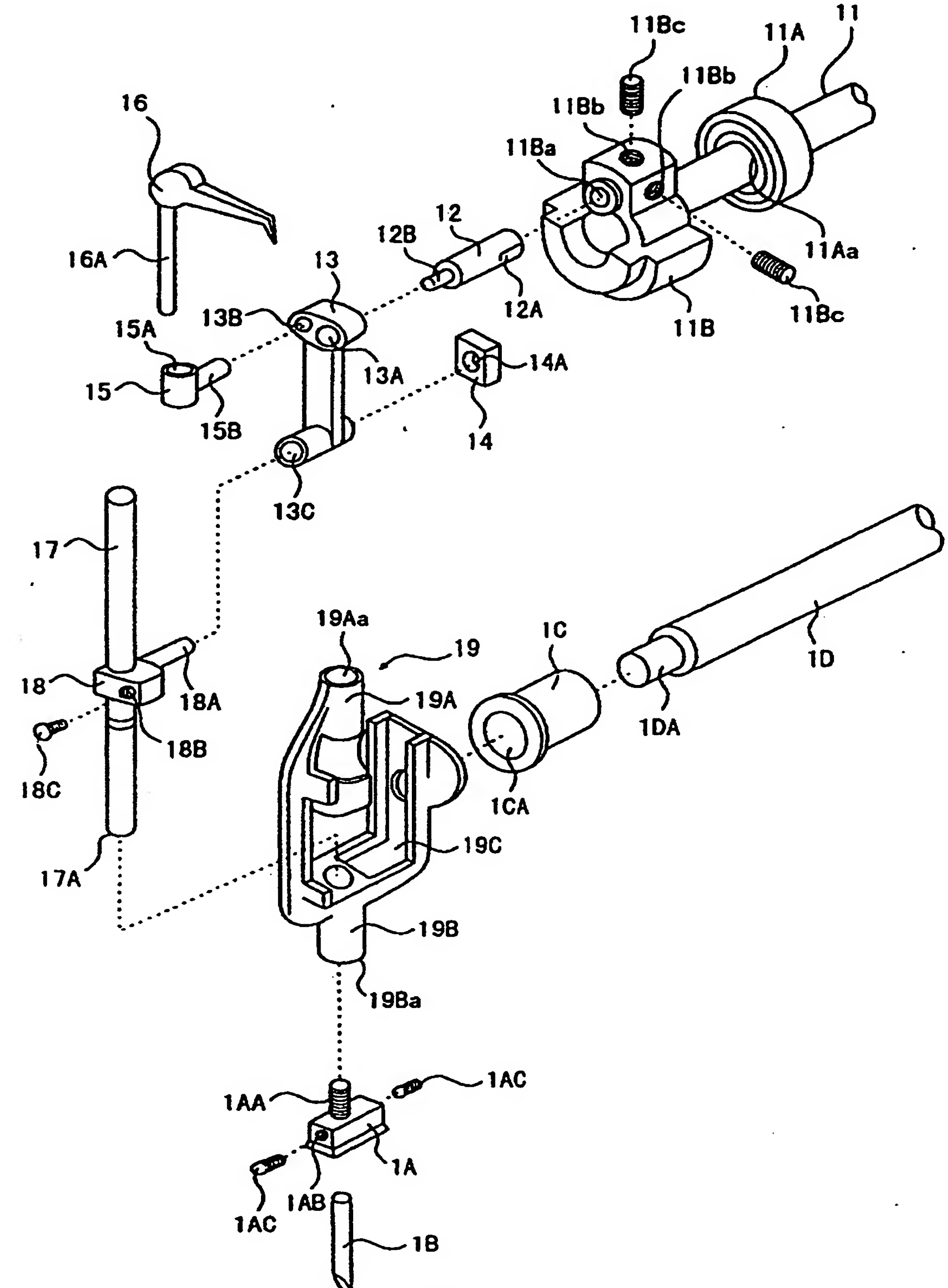
根据本发明之 1 的缝纫机，用摩擦系数小的硬质多孔性碳素材料制成形成所述摩擦面的部分，能够实现无供油化。

而且，不需要向所述接触部供给润滑油的供油装置，因此能实现轻量化。而且，例如由于使用的是比金属等密度小的硬质多孔性碳素材料，所以，可进一步实现轻量化。

而且，由于不需要供油装置，因此能够削减缝纫机部件数，可降低缝纫机的制造负荷和削减制造成本。

根据本发明之 2 的缝纫机，轴状部沿环状部的内面在圆周方向上的旋转移动，或沿内面的轴方向滑动移动，同时由于其摩擦面是由上述硬质多孔性碳素材料制成的，所以，与本发明之 1 同样，能够实现对构成

说 明 书 附 图



11Bc
11A
11
11Bb
16
11Bb
11Ba
12
12B
11Aa
16A
13
13B
12A
11Bc
15A
11B
14A
13A
15
15B
14
13C
17
19Aa
1C
19
1D
18
18A
19A
1DA
18C
18B
1CA
19C
17A
19B
19Ba
1AA
1AC
1A
1AB
1AC
1B

图 1